

Final Report

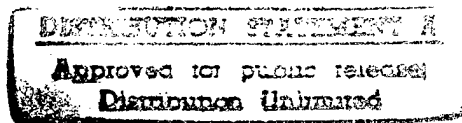
EXECUTIVE SUMMARY

**FEASIBILITY STUDY FOR HVAC UPGRADE  
FORT RILEY, KANSAS**

**ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)**

Prepared for

U.S. Army Corps of Engineers  
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## VOLUME II - FIELD SURVEY FORMS

(Under separate cover)

## LIST OF ABBREVIATIONS

ACC	- air cooled condenser
ACCU	- air cooled condensing unit
AHU	- air handling unit
ANSI	- American National Standards Institute
ASCE	- American Society of Civil Engineers
BLR	- boiler
CDP	- condensate pump
CH	- chiller
CNW	- condenser water
CNWR	- condenser water return
CNWS	- condenser water supply
COE	- Corps of Engineers
CV	- converter
CW	- chilled water
CWP	- chilled water pump
CWR	- chilled water return
CWS	- chilled water supply
EZDOE	- Computer program used for calculating building hour energy use.
DD	- dual duct
DDC	- direct digital control
DHRW	- dehumidification heat recovery unit
DTW	- dual temperature water
DTWP	- dual temperature water pump
DX	- direct expansion
ECO	- Energy Conservation Opportunity
EMC	- E M C Engineers, Inc.
F	- fahrenheit
FC	- fan coil
ft	- foot, feet
ft <sup>2</sup>	- square feet
gal	- gallons
gpm	- gallons per minute
hp	- horsepower
hr	- hour
HRU	- heat recovery unit
HW	- hot water
HWP	- hot water pump
HWR	- hot water return
HWS	- hot water supply
H&V	- heating and ventilating
IR	- infrared radiant
kW	- kilowatt, one thousand watts
kWh	- kilowatt-hours, one thousand watt-hours
lb/hr	- pounds per hour
LCCA	- life cycle cost analysis
MAU	- make-up air unit

MZ	- multizone
O&M	- operation and maintenance
OA	- outside air
psia	- pounds per square inch absolute
psig	- pounds per square inch gage
RA	- return air
RAD	- radiation heating system
RAF	- return air fan
rpm	- revolutions per minute
SOW	- scope of work
sq ft	- square foot
STM	- steam
SZ	- single zone
temp.	- temperature
UH	- unit heater
UMCS	- utility monitoring and control system
VAV	- variable air volume
VSD	- variable speed drive
WAC	- window air conditioner
yr	- year(s)

## **EXECUTIVE SUMMARY**

### **OBJECTIVE**

The Feasibility Study for HVAC Upgrade was performed as part of the Energy Engineering Analysis Program (EEAP). The purpose of the Feasibility Study for HVAC Upgrade is to determine the economic feasibility of replacing failed or failing HVAC equipment in 70 buildings at Fort Riley, Kansas. This study is being performed in conjunction with the Feasibility Study for Installation of UMCS at Fort Riley. Two hundred sixteen buildings are evaluated in the UMCS study.

### **FACILITY DATA AND BUILDING SELECTION**

Several types of buildings are evaluated in this study. The building types include administration buildings, barracks, chapels, clinics, dining facilities, maintenance shop buildings, recreational facilities, flight simulator buildings, and training buildings. The energy sources for these buildings include two fuel types, electricity and natural gas.

Seventy buildings were selected from a list of 216 buildings, which are also included in the UMCS feasibility study. Three data sources were used to select the buildings with failed or failing HVAC systems for the analysis. The three data sources included:

- Building lists from the Fort Riley Public Works Energy Branch of specific buildings to include in the analysis.
- List of 235 buildings from the Fort Riley Maintenance Shop listing the condition of HVAC systems and controls.
- Field survey data from 216 buildings surveyed by EMC Engineers, Inc. for the purpose of an UMCS feasibility study.

### **METHODOLOGY**

A field survey was performed to document the HVAC system components for repair and to document information for replacement of existing HVAC systems. HVAC system components were visually inspected for damage, missing parts, and functionality. The HVAC systems were also observed for possible replacement with new, more efficient HVAC systems. Mechanical equipment rooms and building spaces were observed for space requirements and clearances for installation of proposed HVAC system replacements. Building use and building space conditions were also observed as part of the field survey for proposed HVAC system replacements.

HVAC system descriptions and conditions were tabulated from the field survey data. The HVAC system components for repair were listed and repair costs developed. Where applicable, the proposed HVAC systems for replacement were identified and evaluated for technical feasibility for those buildings. Construction costs were developed for the proposed HVAC replacement systems.

The energy savings for HVAC replacement systems were estimated through computer modeling of the existing and the proposed energy efficient HVAC systems. Representative buildings from the UMCS feasibility study were used as the baseline computer models in this analysis. Energy savings for proposed HVAC replacement systems from the representative buildings were prorated on a square foot basis to derive energy savings for similar building HVAC system replacements.

Life cycle cost analyses were performed for the proposed HVAC system replacements in accordance with ECIP guidance, using the calculated energy savings and systems replacement costs. Energy savings and costs for the proposed HVAC system replacements were summarized.

## SUMMARY

HVAC system components in need of repair were found in 40 of the 70 buildings evaluated.

The proposed HVAC system replacements were analyzed for 39 of the 70 buildings evaluated. A total of 51 proposed HVAC system replacements were analyzed. The economic analysis for the proposed HVAC system replacements revealed that 32 of the 51 HVAC systems analyzed qualified for the ECIP funding program (simple paybacks below 10 years and SIRs greater than 1.25).

## RECOMMENDATIONS

The HVAC system components, presented in Table ES-1 on page ES-4, are recommended for repair to restore the existing HVAC systems to their intended operating condition. Some of the HVAC systems evaluated overlapped between the analyses for HVAC repair and replacement. Those HVAC systems which qualified economically for replacement were removed from the HVAC components for repair list. The total cost for the recommended HVAC system components for repair is \$56,887.

The HVAC systems, presented in Table ES-2 on page ES-5, are recommended for replacement with more energy efficient HVAC systems. The 32 proposed HVAC system replacements which qualified for the ECIP funding program are recommended to be submitted for project funding.

The proposed HVAC systems not qualifying for the ECIP funding program were not recommended for replacement. The nonrecommended HVAC system replacements are presented in Table ES-3 on page ES-7.



**TABLE ES-1  
RECOMMENDED HVAC COMPONENTS FOR REPAIR**

BLDG TYPE	BLDG NO.	BLDG NAME	DESCRIPTION OF HVAC COMPONENTS FOR REPAIR	REPAIR COST (\$)
Admin. Buildings	302	FINANCE ADMIN	FAN BEARING	91
	313	CIV PERS BLDG	CONDENSER COIL (PLUS COVER)	797
	7636	REGIMENTAL HQ BLDG	CONTROL VALVE 2-1/2"	1,050
	8056	DET DAY ROOM	PUMP, 3/4 HP	744
Admin. & Supply Buildings	7602	ADMIN & SUPPORT BLDG	COOLING COIL, 2ROW, 30" x 30", STEEL PIPE SCH. 40, 1.25" W/HANGERS & 1.25" FIBERGLASS PIPE INSULATION, 1.5" THCK	3,914
	7608	ADMIN & SUPPLY BLDG	COOLING COIL, 2ROW, 30" x 30", STEEL PIPE SCH. 40, 1.25" W/HANGERS & 1.25" FIBERGLASS PIPE INSULATION, 1.5" THCK	3,914
	7652	ADMIN & SUPPLY BLDG	COOLING COIL, 2ROW, 30" x 30", STEEL PIPE SCH. 40, 1.25" W/HANGERS & 1.25" FIBERGLASS PIPE INSULATION, 1.5" THCK	3,914
	7658	ADMIN & SUPPLY BLDG	COOLING COIL, 2ROW, 30" x 30", STEEL PIPE SCH. 40, 1.25" W/HANGERS & 1.25" FIBERGLASS PIPE INSULATION, 1.5" THCK	3,914
Barracks Buildings	7612	ENL BARRACKS W/AS	PUMP SEAL	208
	7614	ENL BARRACKS W/AS	PUMP SEAL	625
	7810	ENL BARRACKS W/O DIN	PUMP SEAL	417
	7814	ENL BARRACKS W/O DIN	PUMP, 2 HP & PUMP SEAL	1,219
	8002	ENL BARRACKS W/O DIN	CONTROL VALVE 1/2" & 3-SPEED FAN SWITCH	2,227
	8012	ENL BARRACKS W/O DIN	CONTROL VALVE 1/2" & 3-SPEED FAN SWITCH	2,227
	8014	ENL BARRACKS W/O DIN	CONTROL VALVE 1/2" & 3-SPEED FAN SWITCH	1,114
	8038	ENL BARRACKS W/O DIN	CONTROL VALVE 1/2" & 3-SPEED FAN SWITCH	2,227
	8040	ENL BARRACKS W/O DIN	CONTROL VALVE 1/2" & 3-SPEED FAN SWITCH	1,114
	8042	ENL BARRACKS W/O DIN	CONTROL VALVE 1/2" & 3-SPEED FAN SWITCH	2,227
	8048	ENL BARRACKS W/O DIN	CONTROL VALVE 1/2" & 3-SPEED FAN SWITCH	1,114
	8050	ENL BARRACKS W/O DIN	CONTROL VALVE 1/2" & 3-SPEED FAN SWITCH	1,114
	8052	SR ENL QTRS	CONTROL VALVE 1/2" & 3-SPEED FAN SWITCH	2,227
Maintenance Shops	723	MNT HANGAR COMB	PUMP SEAL, CONDENSATE PUMP GASKET & CONDENSATE SHUT-OFF CONTROLS	1,439
	727	MNT HANGAR COMB	DAMPER ACTUATOR, PUMP SEAL, CONDENSATE PUMP GASKET, CONDENSATE SHUT-OFF CONTROLS & PUMP MOTOR, 1/3 HP	1,935
	741	MNT HANGAR COMB	REPLACE FOUR STEAM HEATING COILS, 980,000 BTUH CAPACITY EACH	4,975
	820	TAC EQUIP SHOP	CONTROL VALVE 1-1/2", PUMP MOTOR, 10 HP & PUMP SEAL	2,094
	8390	TAC EQUIP SHOP	DAMPER ACTUATOR, CONTROL VALVE 1" & CONTROL VALVE 3/4"	1,975
Recreation & Retail Facilities	202	PHYS FITNESS CTR	CONDENSER COIL (PLUS COVER)	979
	7485	BOWLING ALLEY	VARIABLE SPEED DRIVE W/ CONTRLER, 10HP	3,459
	6914	EXC MAIN RETL	CONTROL VALVE 1-1/2", CONTROL VALVE 2", CONTROL VALVE 1-1/4" & DAMPER ACTUATOR	2,098
	6940	INDOOR SWIM POOL	DAMPER ACTUATOR	223
Simulator Building	7739	MOVING TARGET SIMULATOR BLDG	DAMPER ACTUATOR	893
Training Building	6620	COMMUN ACT CTR	PUMP SEAL	417
<b>TOTAL REPAIR COST</b>				<b>\$56,887</b>

**TABLE ES-2  
RECOMMENDED HVAC SYSTEM REPLACEMENTS**

BLDG NO.	BLDG NAME	PROPOSED HVAC SYSTEM TYPE	NAT. GAS ENERGY SAVINGS (MBtu/yr)	ELEC. ENERGY SAVINGS (MBtu/yr)	TOTAL ENERGY SAVINGS (MBtu/yr)	NAT. GAS COST SAVINGS (\$/yr)	ELEC. COST SAVINGS (\$/yr)	DEMAND KW COST SAVINGS (\$/yr)	TOTAL ENERGY COST SAVINGS (\$/yr)	ANNUAL MAINT. SAVINGS (\$/yr)	NON-RECURRING SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (yrs)	SIR
7485	BOWLING ALLEY	Convert DD to DD w/ VAV	(293)	488	196	(\$1,205)	\$5,907	\$850	\$5,552	\$0	\$0	\$15,055	2.71	5.61
7665	DENTAL CLINIC	Convert MZ to VAV	(107)	301	194	(\$440)	\$3,637	\$637	\$3,834	\$0	\$0	\$12,210	3.18	4.85
7670	DENTAL CLINIC	Convert DD to DD w/ VAV	(173)	889	716	(\$713)	\$10,760	\$958	\$11,006	\$0	\$0	\$40,355	3.67	4.26
602	DENTAL CLINIC	Convert DD to DD w/ VAV	(132)	681	548	(\$546)	\$8,237	\$1,242	\$8,934	\$0	\$0	\$35,342	3.96	3.94
6940	INDOOR SWIM POOL	Replace H&V with Heat Recovery Unit	7,727	706	8,434	\$31,836	\$8,545	\$0	\$40,381	\$0	\$0	\$199,226	4.93	3.61
7245	ENL PERS DIN	Replace Kitchen MAUs and Exhaust Fans with Heat Recovery Units	3,511	103	3,614	\$14,465	\$1,250	\$332	\$16,047	\$0	\$30,377	\$90,334	5.14	3.49
7606	ENL PERS DIN	Replace Kitchen MAUs and Exhaust Fans with Heat Recovery Units	3,511	103	3,614	\$14,465	\$1,250	\$332	\$16,047	\$0	\$30,377	\$90,334	5.14	3.49
7654	ENL PERS DIN	Replace Kitchen MAUs and Exhaust Fans with Heat Recovery Units	3,511	103	3,614	\$14,465	\$1,250	\$332	\$16,047	\$0	\$30,377	\$90,334	5.14	3.49
7804	ENL PERS DIN	Replace Kitchen MAUs and Exhaust Fans with Heat Recovery Units	3,511	103	3,614	\$14,465	\$1,250	\$332	\$16,047	\$0	\$30,377	\$90,334	5.14	3.49
7856	ENL PERS DIN	Replace Kitchen MAUs and Exhaust Fans with Heat Recovery Units	3,511	103	3,614	\$14,465	\$1,250	\$332	\$16,047	\$0	\$30,377	\$90,334	5.14	3.49
6620	COMMUN ACT CTR	Replace SZ AHUs with VAV AHUs	199	478	677	\$821	\$5,778	\$539	\$7,138	\$0	\$30,326	\$47,075	5.44	2.99
7404	ENL BARRACKS W/O DIN	Convert two MZs to VAVs	0	364	364	\$0	\$4,402	\$378	\$4,780	\$0	\$0	\$26,055	5.45	2.90
410	ENL BARRACKS WAS	Replace MZs with VAV AHUs	(730)	997	267	(\$3,008)	\$12,061	\$1,309	\$10,362	\$0	\$51,813	\$77,512	5.98	2.59
402	ENL BARRACKS WAS	Replace MZs and SZ with VAV AHUs	(730)	997	267	(\$3,008)	\$12,061	\$1,309	\$10,362	\$0	\$49,221	\$78,851	6.15	2.52
5000	FIRE STATION	Replace MZ with 3 Furnance AC Units, Replace Boiler with smaller Boiler, and Replace ACCU with 3 smaller ACCUs	196	82	278	\$808	\$991	(\$47)	\$1,752	\$652	\$72,986	\$41,284	6.82	2.48
7245	ENL PERS DIN	Replace Large Steam Boiler w/ Smaller Steam & HW Boilers	1,528	(111)	1,417	\$6,295	(\$1,338)	\$0	\$4,957	(\$181)	\$101,942	\$72,585	7.35	2.47
6620	COMMUN ACT CTR	Convert MZ to VAV	(9)	176	167	(\$35)	\$2,129	(\$122)	\$1,972	\$0	\$0	\$13,076	6.63	2.40
7804	ENL PERS DIN	Replace Large Steam Boiler w/ Smaller Steam & HW Boilers	1,528	(111)	1,417	\$6,295	(\$1,338)	\$0	\$4,957	(\$181)	\$101,942	\$78,207	7.92	2.29
7866	ENL PERS DIN	Replace Large Steam Boiler w/ Smaller Steam & HW Boilers	1,528	(111)	1,417	\$6,295	(\$1,338)	\$0	\$4,957	(\$181)	\$101,942	\$78,207	7.92	2.29
227	ENL BARRACKS WAS	Replace MZs and SZs with VAV AHUs	(852)	1,163	311	(\$3,510)	\$14,071	\$1,527	\$12,069	\$0	\$70,248	\$111,119	7.12	2.18
7806	BN HQ BLDG	Replace SZs with VAV AHUs	(95)	263	168	(\$392)	\$3,183	\$735	\$3,526	\$0	\$23,323	\$34,973	7.45	2.13
7086	UNIT CHAPEL	Replace SZ with VAV AHU	122	92	214	\$504	\$1,108	\$183	\$1,794	\$0	\$12,554	\$19,280	7.96	2.09
222	ADMIN GEN PURP	Replace SZ with VAV AHU	(127)	260	133	(\$523)	\$3,145	\$809	\$3,431	\$0	\$14,214	\$31,811	7.68	2.03
7606	ENL PERS DIN	Replace Large Steam Boiler w/ Smaller Steam & HW Boilers	1,528	(111)	1,417	\$6,295	(\$1,338)	\$0	\$4,957	(\$181)	\$101,942	\$89,312	9.05	2.01
7654	ENL PERS DIN	Replace Large Steam Boiler w/ Smaller Steam & HW Boilers	1,528	(111)	1,417	\$6,295	(\$1,338)	\$0	\$4,957	(\$181)	\$101,942	\$89,312	9.05	2.01
8069	INDOOR SW POOL/GYM	Replace H&V with Heat Recovery Unit	3,223	295	3,517	\$13,277	\$3,563	\$0	\$16,840	\$0	\$35,706	\$173,802	9.33	1.90
7178	MOTOR POOL ADMIN	Replace 3 Win. ACs with small SZ w/ DX coil	0	52	52	\$0	\$628	\$826	\$1,454	(\$141)	\$4,071	\$12,511	8.25	1.89
7245	ENL PERS DIN	Replace SZ AHUs in Dining Area with VAV AHUs	(279)	287	8	(\$1,151)	\$3,477	\$381	\$2,707	\$0	\$21,050	\$33,367	8.80	1.74

**TABLE ES-2  
RECOMMENDED HVAC SYSTEM REPLACEMENTS**

BLDG NO.	BLDG NAME	PROPOSED HVAC SYSTEM TYPE	NAT. GAS ENERGY SAVINGS (MBtu/yr)	ELEC. ENERGY SAVINGS (MBtu/yr)	TOTAL ENERGY SAVINGS (MBtu/yr)	NAT. GAS COST SAVINGS (\$/yr)	ELEC. COST SAVINGS (\$/yr)	DEMAND KW COST SAVINGS (\$/yr)	TOTAL ENERGY COST SAVINGS (\$/yr)	ANNUAL MAINT. SAVINGS (\$/yr)	NON-RECURRING SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (yrs)	SIR
7606	ENL PERS DIN	Replace SZ AHUs in Dining Area with VAV AHUs	(279)	287	8	(\$1,151)	\$3,477	\$381	\$2,707	\$0	\$21,050	\$33,387	8.80	1.74
7654	ENL PERS DIN	Replace SZ AHUs in Dining Area with VAV AHUs	(279)	287	8	(\$1,151)	\$3,477	\$381	\$2,707	\$0	\$21,050	\$33,387	8.80	1.74
7804	ENL PERS DIN	Replace SZ AHUs in Dining Area with VAV AHUs	(279)	287	8	(\$1,151)	\$3,477	\$381	\$2,707	\$0	\$21,050	\$33,387	8.80	1.74
7856	ENL PERS DIN	Replace SZ AHUs in Dining Area with VAV AHUs	(279)	287	8	(\$1,151)	\$3,477	\$381	\$2,707	\$0	\$21,050	\$33,387	8.80	1.74
TOTALS FOR ENERGY SAVINGS, COST SAVINGS, AND INVESTMENTS			32,019	9,679	41,698	\$131,911	\$117,151	\$14,698	\$263,762	(\$394)	\$1,131,307	\$1,995,765	-	-

**TABLE ES-3  
NONRECOMMENDED HVAC SYSTEM REPLACEMENTS**

BLDG NO.	BLDG NAME	PROPOSED HVAC SYSTEM TYPE	NAT. GAS ENERGY SAVINGS (MBtu/yr)	ELEC. ENERGY SAVINGS (MBtu/yr)	TOTAL ENERGY SAVINGS (MBtu/yr)	NAT. GAS COST SAVINGS (\$/yr)	ELEC. COST SAVINGS (\$/yr)	DEMAND KW COST SAVINGS (\$/yr)	TOTAL ENERGY COST SAVINGS (\$/yr)	ANNUAL MAINT. SAVINGS (\$/yr)	NON-RECURRING SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (yrs)	SIR
7176	MOTOR POOL MNT SHO	Replace UHs and Steam Boiler with IR Tube Heating System	83	28	112	\$343	\$344	\$0	\$688	\$600	\$24,734	\$27,000	10.70	1.56
3	POST CHAPEL	Replace SZ, H&V, Slim Boiler and Cooling Tower with VAV AHU, HW Boiler, and Water Chiller	212	136	348	\$874	\$1,649	\$131	\$2,653	\$724	\$48,583	\$68,200	11.75	1.42
820	TAC EQUIP SHOP	Replace HW UHs with Gas-fired Infrared Radiant Tube System; Down size HW Boiler	104	11	115	\$427	\$133	\$0	\$560	\$370	\$43,700	\$37,546	12.05	1.42
7739	MOVING TARGET SIMULATOR BLDG	Replace MZ with VAV AHU	(37)	101	65	(\$151)	\$1,227	\$283	\$1,359	\$0	\$14,830	\$27,484	13.09	1.23
741	MNT HANGAR COMB	Replace Industrial Type UHs with Gas-fired Infrared Radiant Tube System	626	213	839	\$2,578	\$2,583	\$0	\$5,161	\$600	\$63,690	\$142,228	15.90	1.07
7602	ADMIN & SUPPLY BLDG	Replace existing SZs with new SZs	0	25	25	\$0	\$302	\$213	\$515	\$0	\$20,550	\$24,083	15.62	1.07
7608	ADMIN & SUPPLY BLDG	Replace existing SZs with new SZs	0	25	25	\$0	\$302	\$213	\$515	\$0	\$20,550	\$24,083	15.62	1.07
7652	ADMIN & SUPPLY BLDG	Replace existing SZs with new SZs	0	25	25	\$0	\$302	\$213	\$515	\$0	\$20,550	\$24,083	15.62	1.07
7658	ADMIN & SUPPLY BLDG	Replace existing SZs with new SZs	0	25	25	\$0	\$302	\$213	\$515	\$0	\$20,550	\$24,083	15.62	1.07
6914	EXC MAIN RETL	Convert two MZs to VAVs	(4)	145	141	(\$18)	\$1,757	(\$18)	\$1,722	\$0	\$0	\$29,431	17.09	0.93
7612	ENL BARRACKS W/AS	Replace FCs and SZs with VAV AHUs	2,176	95	2,271	\$8,964	\$1,151	(\$1,233)	\$8,881	\$5,147	\$179,196	\$434,560	18.90	0.91
7614	ENL BARRACKS W/AS	Replace FCs and SZs with VAV AHUs	2,176	95	2,271	\$8,964	\$1,151	(\$1,233)	\$8,881	\$5,147	\$179,196	\$434,560	18.90	0.91
7616	ENL BARRACKS W/AS	Replace FCs and SZs with VAV AHUs	2,176	95	2,271	\$8,964	\$1,151	(\$1,233)	\$8,881	\$5,147	\$179,196	\$434,560	18.90	0.91
7810	ENL BARRACKS W/AS	Replace FCs and SZs with VAV AHUs	2,176	95	2,271	\$8,964	\$1,151	(\$1,233)	\$8,881	\$5,147	\$179,196	\$434,560	18.90	0.91
7814	ENL BARRACKS W/AS	Replace FCs and SZs with VAV AHUs	2,176	95	2,271	\$8,964	\$1,151	(\$1,233)	\$8,881	\$5,147	\$179,196	\$434,560	18.90	0.91
8069	INDOOR SW POOL/GYM	Replace H&V with Heat Recovery, Dehumidification, and Pool Heating Unit	3,223	(559)	2,663	\$13,277	(\$6,769)	\$0	\$6,508	\$0	\$35,706	\$202,172	24.38	0.82
7243	ADMIN & SUPPLY BLDG	Replace 15 Win. ACs with 5 small SZs w/ DX coils	0	50	50	\$0	\$600	\$790	\$1,390	(\$704)	\$19,638	\$43,596	26.13	0.64
8025	BN ADMIN & CLRM	Convert MZs to VAVs	0	65	65	\$0	\$791	(\$112)	\$679	\$0	\$0	\$17,282	25.45	0.63
202	PHYS FITNESS CTR	Replace two Industrial Type Unit Heaters in Basketball Gym with four H&V Units	148	20	167	\$609	\$236	\$48	\$894	\$0	\$17,611	\$64,001	36.08	0.48

Five energy retrofit projects were identified for HVAC upgrade by the Fort Riley Public Works Energy Branch. These projects were recommended for funding under the Federal Energy Management Program (FEMP). The five projects are presented in Table ES-4.

**Table ES-4. HVAC Energy Retrofit Projects Recommended for FEMP**

<b>Project No.</b>	<b>Project Description</b>
<b>Project No. 1 Upgrade HVAC Systems in Dental Clinics</b>	
	<ul style="list-style-type: none"> <li>• Building 602 - Convert DD AHU to DD VAV AHU</li> </ul>
	<ul style="list-style-type: none"> <li>• Building 7665 - Convert MZ AHU to VAV AHU</li> </ul>
	<ul style="list-style-type: none"> <li>• Building 7670 - Convert DD AHU to DD VAV AHU</li> </ul>
<b>Project No. 2 Upgrade HVAC Systems in Dining Facilities</b>	
	<ul style="list-style-type: none"> <li>• Building 7245 <ul style="list-style-type: none"> <li>- Replace SZ AHUs with VAV AHUs</li> <li>- Replace MAUs with HRUs</li> <li>- Replace large STM BLR with smaller HW BLR and smaller STM BLR</li> </ul> </li> </ul>
	<ul style="list-style-type: none"> <li>• Building 7606 <ul style="list-style-type: none"> <li>- Replace SZ AHUs with VAV AHUs</li> <li>- Replace MAUs with HRUs</li> <li>- Replace large STM BLR with smaller HW BLR and smaller STM BLR</li> </ul> </li> </ul>
	<ul style="list-style-type: none"> <li>• Building 7654 <ul style="list-style-type: none"> <li>- Replace SZ AHUs with VAV AHUs</li> <li>- Replace MAUs with HRUs</li> <li>- Replace large STM BLR with smaller HW BLR and smaller STM BLR</li> </ul> </li> </ul>
<b>Project No. 3 Upgrade HVAC Systems in Indoor Swimming Pool Buildings</b>	
	<ul style="list-style-type: none"> <li>• Building 6940 - Replace H&amp;V with HRU</li> </ul>
	<ul style="list-style-type: none"> <li>• Building 8069 - Replace H&amp;Vs with HRUs</li> </ul>
<b>Project No. 4 Upgrade HVAC Systems in Bowling Alley and Community Activities Center</b>	
	<ul style="list-style-type: none"> <li>• Building 7485 (Bowling Alley) - Convert DD AHU to DD VAV AHU</li> </ul>
	<ul style="list-style-type: none"> <li>• Building 6620 (Community Activities Center) <ul style="list-style-type: none"> <li>- Replace SZ AHUs with VAV AHUs</li> <li>- Convert MZ AHU to VAV AHU</li> </ul> </li> </ul>

Project No.	Project Description
<b>Project No. 5</b>	<b>Upgrade HVAC Systems in Fire Station, Unit Chapel, Motor Pool Admin, and Battalion Headquarters</b>
	<ul style="list-style-type: none"> <li>• Building 5000 (Fire Station) BLR <ul style="list-style-type: none"> <li>- Replace MZ AHU with three Furnace Air Conditioners</li> <li>- Replace ACCU with three Smaller ACCUs</li> <li>- Replace HW Boiler with Smaller Modular HW</li> </ul> </li> </ul>
	<ul style="list-style-type: none"> <li>• Building 7086 (Unit Chapel) <ul style="list-style-type: none"> <li>- Replace SZ AHU with VAV AHU</li> </ul> </li> </ul>
	<ul style="list-style-type: none"> <li>• Building 7178 (Motor Pool Admin) <ul style="list-style-type: none"> <li>- Replace three WACs with SZ AHU and ACCU</li> </ul> </li> </ul>
	<ul style="list-style-type: none"> <li>• Building 7806 (Battalion Headquarters) <ul style="list-style-type: none"> <li>- Replace SZ AHU with VAV AHUs</li> </ul> </li> </ul>

The energy savings and economic parameters for the projects are presented in Table ES-5 on the page ES-10.

**TABLE ES-5**  
**ECONOMIC SUMMARY FOR ENERGY RETROFIT PROJECTS**

FEMP ENERGY RETROFIT PROJECT FOR HVAC UPGRADE	NAT. GAS ENERGY SAVINGS (MBtu/yr)	ELEC. ENERGY SAVINGS (MBtu/yr)	TOTAL ENERGY SAVINGS (MBtu/yr)	NAT. GAS COST SAVINGS (\$/yr)	ELEC. COST SAVINGS (\$/yr)	DEMAND KW COST SAVINGS (\$/yr)	TOTAL ENERGY COST SAVINGS (\$/yr)	ANNUAL MAINT. SAVINGS (\$/yr)	NON- RECURRING SAVINGS (\$)	TOTAL INVESTMENT (\$)	SIMPLE PAYBACK (yrs)	SIR
Project No. 1 Dental Clinics (Bldgs 602, 7665, 7670)	(412)	1,871	1,459	(\$1,697)	\$22,639	\$2,837	\$23,779	\$0	\$0	\$87,908	3.70	4.22
Project No. 2 Dining Facilities (Bldgs 7245, 7606, and 7654)	14,280	837	15,117	\$58,834	\$10,128	\$2,139	\$71,100	(\$543)	\$460,107	\$622,370	6.65	2.66
Project No. 3 Indoor Swimming Pools (Bldgs 6940 and 8069)	10,950	1,001	11,951	\$45,114	\$12,112	\$0	\$57,226	\$0	\$35,706	\$373,029	6.32	2.81
Project No. 4 Bowling Alley and Comm. Act. Center (Bldgs 7485 and 6620)	(103)	1,142	1,039	(\$424)	\$13,818	\$1,267	\$14,661	\$0	\$30,326	\$75,206	4.65	3.41
Project No. 5 Fire Station, Unit Chapel, Motor Pool Admin, and Bn HQ (Bldgs 5000, 7086, 7178, and 7806)	223	489	712	\$919	\$5,917	\$1,697	\$8,533	\$511	\$112,934	\$108,048	7.36	2.23